WFO Taunton Post Event Analysis
Event 2004_01:
"A Classic Pulse Severe Episode in the WFO BOX County Warning Area"

Introduction

A broken line of pulse type convective storms (Lemon, 1977), forced by an approaching cold front, developed across eastern New York State during the afternoon of 15 May 2004. The convective elements moved slowly eastward across the Taunton County Warning Area (CWA) during the late afternoon, producing severe weather in the form of wind damage across a small portion of west central Franklin County.

The warning team performed quite well, issuing a series of products during the event, which included short term forecasts, a special weather statement as the main cell approached severe intensity, and one severe thunderstorm warning. The warning team utilized the pulse convection warning guidance provided in a study conducted by WFO Albany (Cerniglia and Snyder, 2002) and successfully verified the only warning issued.

While this was by no means a widespread and damaging event, it provides an excellent example of pulse storm behavior in the WFO BOX CWA and allows forecasters, for the first time, a look at the high resolution Digital Vertically Integrated Liquid (DVIL) product during a pulse severe event.

Synoptic Setting

Numerical Weather Prediction guidance (NWP) was forecasting the passage of a cold front during the mid and late afternoon on 15 May 2004. Midnight shift forecasters noted that Convective Available Potential Energy (CAPE) was forecast to be in the modest range, approaching 2000 J/Kg with sufficient moisture to warrant at least scattered convection. It was noted in the Area Forecast Discussion, that forecast maximum temperatures in the 85-90 degree range were 5 to 10 degrees warmer than indicated by the models. This warmer forecast would therefore allow for greater CAPE and at least the isolated occurrence of a Pulse Severe mode of convection in the western part of the forecast area. The 00Z Eta model forecast for mean sea level pressure, CAPE and moisture convergence is shown in Figure 1, valid 18 UTC, 15 May 2004. Note the access of moisture convergence and CAPE across the western portion of our CWA. In addition, the CWA was in the favored right entrance region to an upper level jet and in at least a modest region of upper level divergence (Figure 1b).

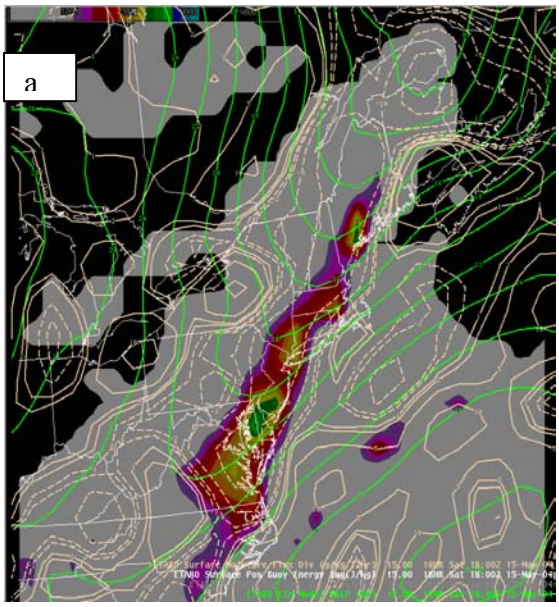

Figure 1a. Eta 18 hour forecast of sea level pressure (green contours every 2 mb), moisture flux divergence (tan contours, g/kg per 12 hr, dashed indicate convergence) and CAPE as an image. Forecast valid 18 UTC 15 May 2004. Start of dark purple shade is at 1000 J/kg.

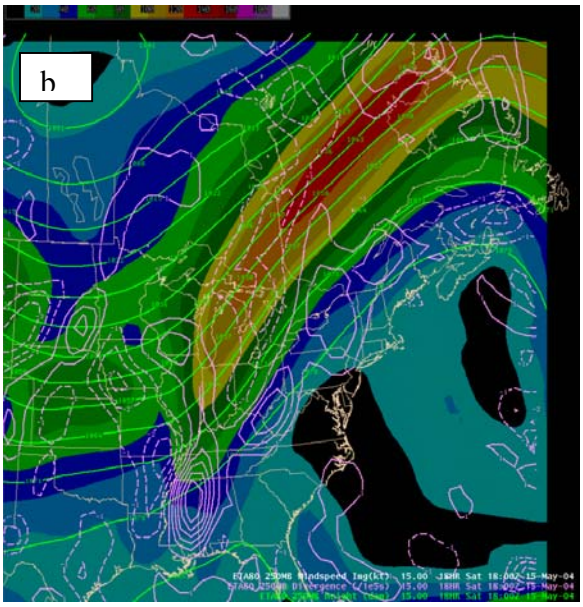

Figure 1b. Eta 18 hour forecast of 250 mb heights (green contours, 60 dm) isotacks as an image, and divergence (magenta contour where solid is divergence. Forecast valid time 18 UTC 15 May 2004.

Convection began to develop across eastern New York State after 1800 UTC and moved through the Taunton CWA between 2100 and 2300 UTC. Figure 2 provides a point sounding valid 21 UTC over Greenfield, MA, as analyzed by the 40 km RUC.

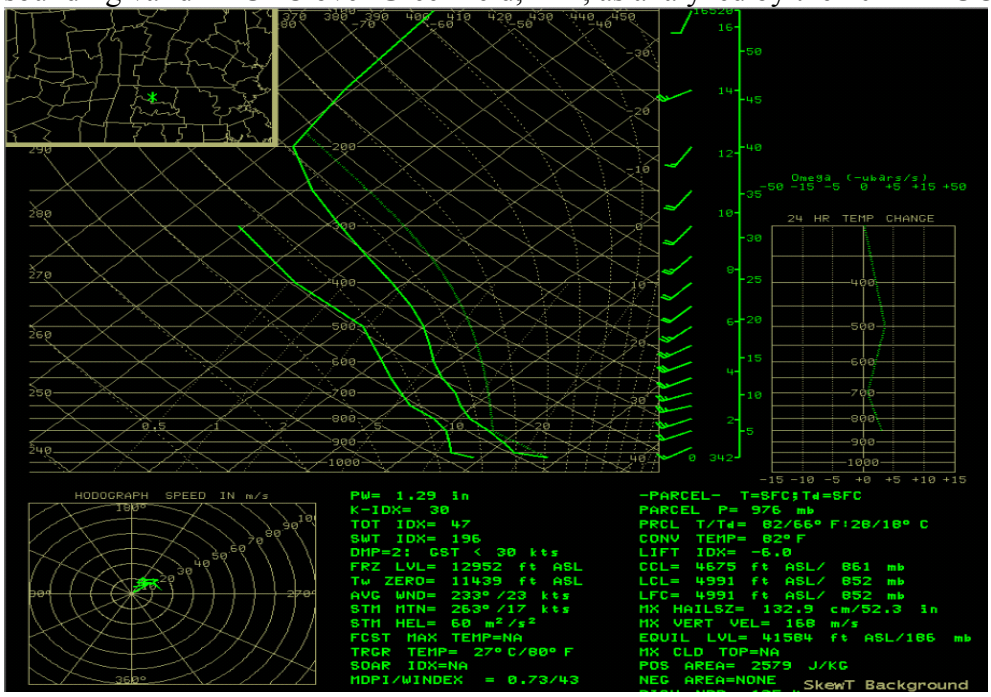

Figure 2. RUC (40 km) analysis sounding in the vicinity of Greenfield, MA, at 2100 UTC 15 May 2004. Surface based CAPE at this time was 2579 J/kg with no CIN.

Radar Characteristics

WSR-88D provided the classic pulse signatures during the life cycle of the event, and for the first time provided a look at real-time DVIL. Figure 3 provides the 4 panel reflectivity for 0.5, 1.5, 2.4 and 3.4 elevation angles at 2145 UTC. This time represents the second, most intense pulse associated with this storm. The severe thunderstorm warning was issued 7 minutes earlier, as the storm began its re-intensification.

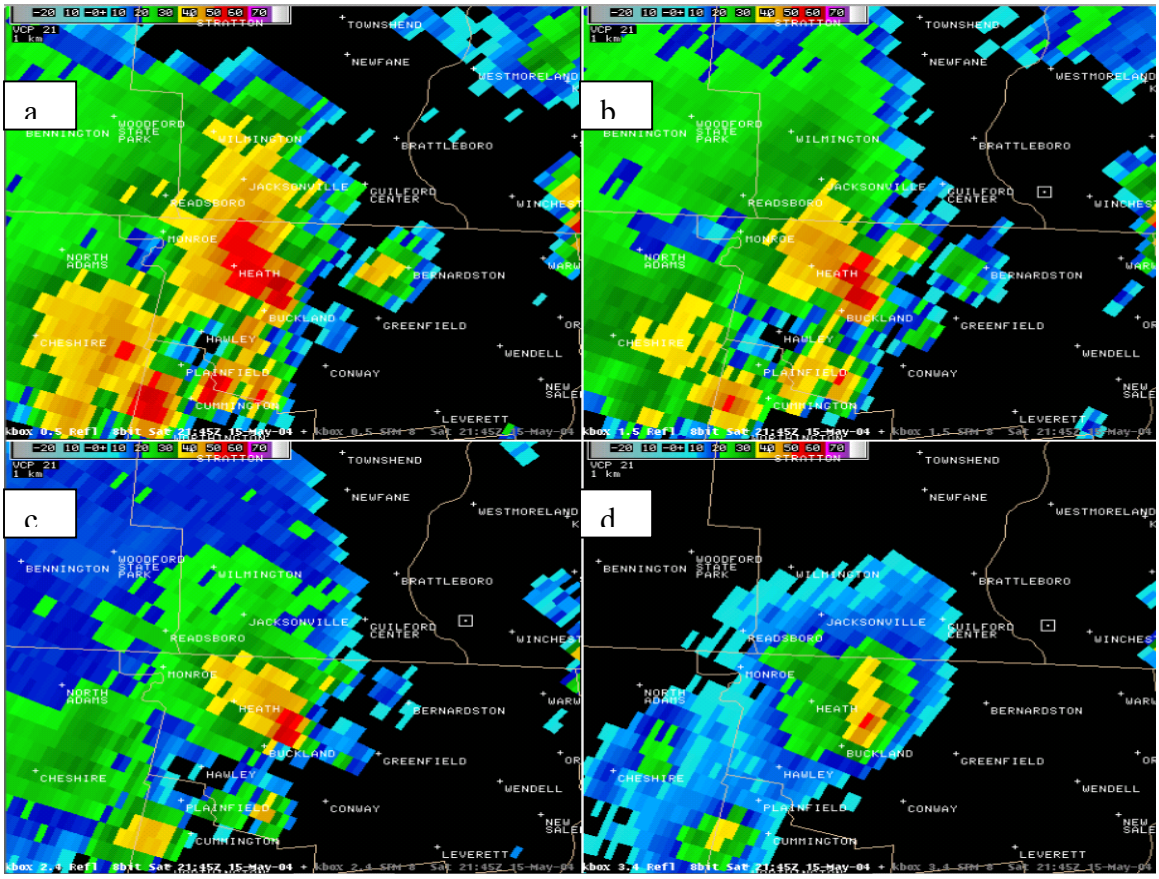

Figure 3. Four panel reflectivity at 2145 UTC. Panel a is at 5 degrees, panel b is at 1.5 degrees, panel c is at 2.4 degrees and panel d is at 3.4 degrees. Note the maximum reflectivity of 50 dBz at 3.4 degrees, which was at approximately 33,000 feet, agl. The first severe event occurred 9 minutes later as the core collapsed.

To see the nature of the storm behavior, Figure 4 provides the maximum dBz values observed over the three lowest elevation angles (1.5, 2.4 and 3.4). Note that while strong reflectivity is noted throughout the storm duration at 1.5, several pulses in excess of 50 dBz occur at elevation 2.4, at time 2228 UTC, 2145 UTC and 2157 UTC. Based on spotter reports, wind damage occurred at 2154 UTC and again at 2203 UTC, or approximately 1 or 2 volume scans following the second and third pulse. This storm appears to have reached maximum intensity at 2145 UTC, as noted by the 50 dBz core (Figure 5) rising to a height of 33,000 ft, agl.

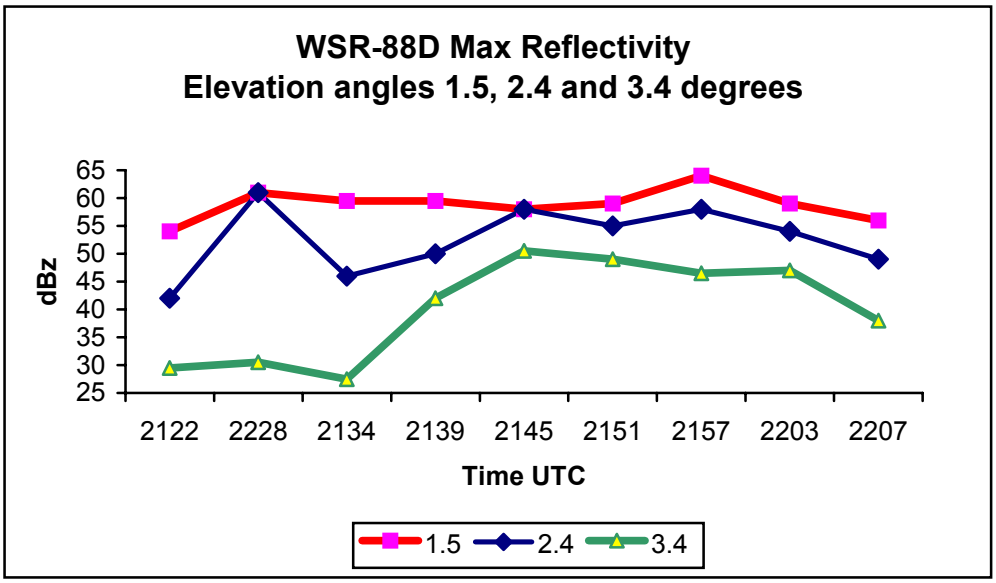

Figure 4. Maximum reflectivity (dBz) observed at radar elevation angles of 1.5, 2.4, and 3.4 degrees during the life cycle of the severe pulse storm over northeast Franklin County.

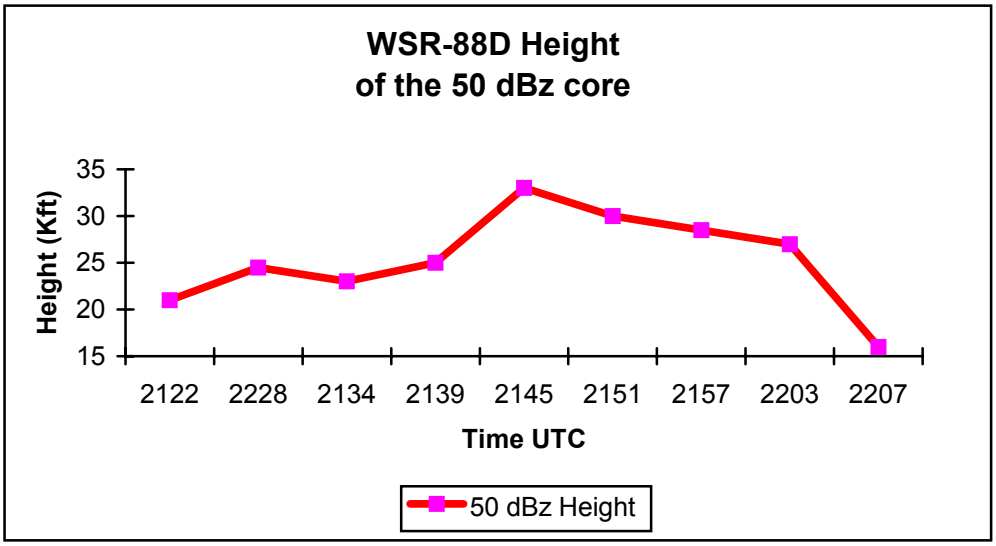

Figure 5. Observed height of the 50 dBz core associated with the severe pulse storm over Northwest Franklin County.

This was the first severe event in which the DVIL product was available. When compared to the standard grid based VIL, DVIL magnitudes are approximately 50% larger, but follow a similar pattern, catching the collapse of the first pulse at 2122 UTC, then maxing out on the second pulse at 2145 UTC (Figure 6).

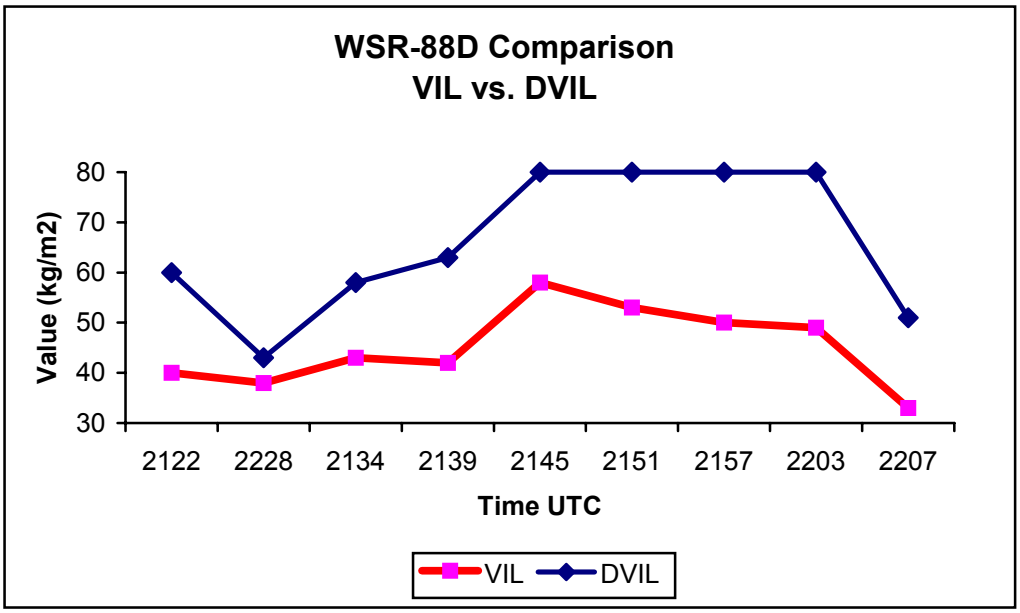

Figure 6. Comparison of gridded VIL vs. DVIL for the severe pulse storm over northwest Franklin County, MA. Note that DVIL magnitudes are approximately 50% larger.

Figures 7a and 7b provide a comparison between the grid based VIL product and the DVIL product. Note the much finer resolution of the storm core, but the much larger values for DVIL.

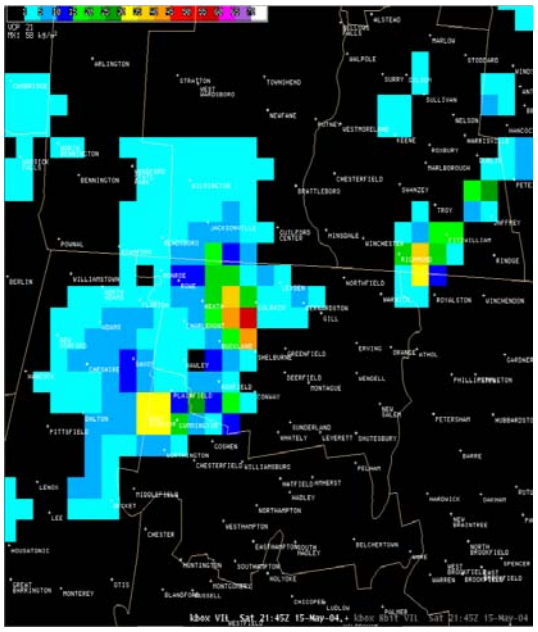

Figure 7a. Grid based VIL valid 2145 UTC 15 May 2004. Core max was 58 kg/m2.

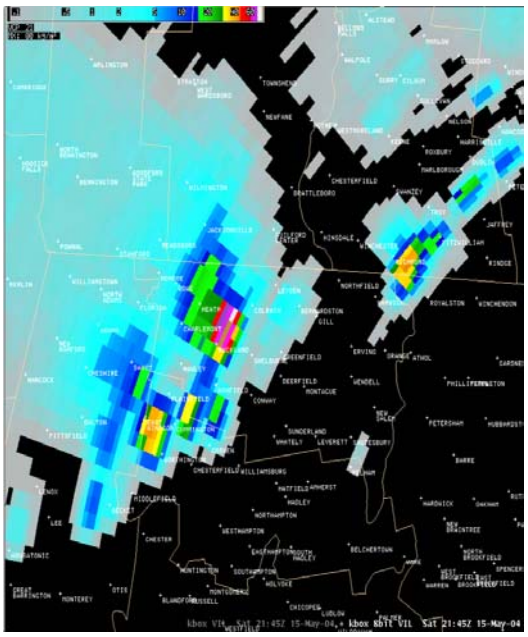

Figure 7b. Digitized VIL (DVIL) valid 2145 UTC 15 May 2004. Core max was 80 kg/m2.

An examination of VIL Density ((VIL/ET)*1000) is provided in Figure 8. The VIL Density spiked sharply at 2145 UTC, reaching a value of 4.23 g/m3. Local research (Maxwell, 1996) at WFO BOX shows that VIL Density values exceeding 4.0 g/m3 will most certainly produce severe weather.

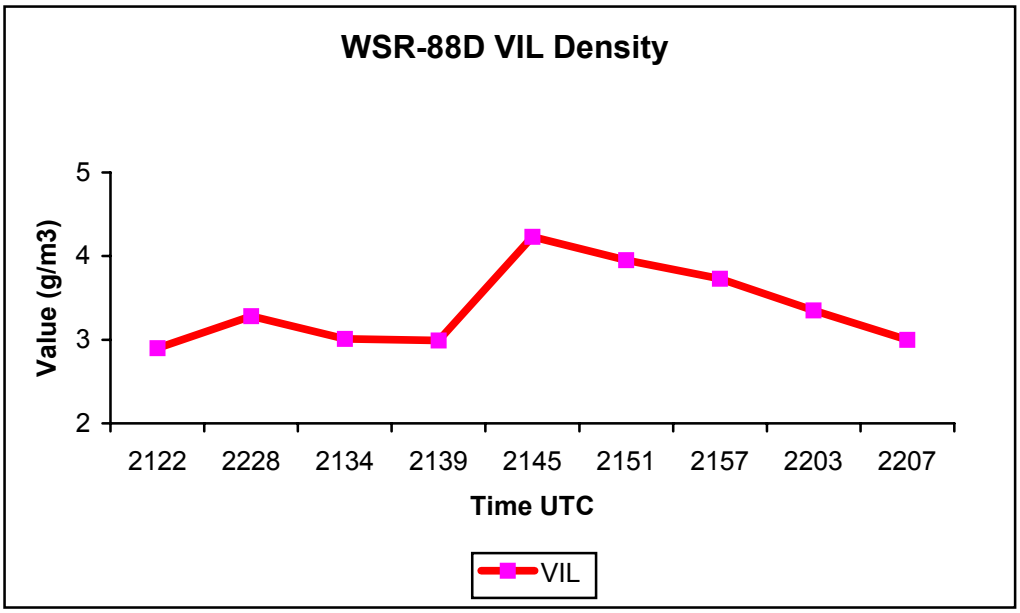

Figure 8. VIL Density over the duration of the storm impacting Franklin County. Note the spike in excess of 4 g/m3.

Warning Verification

Only one Severe Thunderstorm Warning was issued, and it was verified by two separate reports of wire down in Greenfield, MA, located in northwest Franklin County. Table 1 provides a log of related products for this event.

Table 1. Product Issuances

Product	Issuance Time	Focus or Verification
HWOBOX	0916 UTC	Mentioned potential for isolated severe convection in the west.
NOWBOX	1954 UTC	Issued for convection approaching the northwest
SPSBOX	2120 UTC	Issued for storm moving into nw MA and sw NH
SVRBOX	2138 UTC	MAC011 // Verified at 2154 and 2203 by wind
SPSBOX	2220 UTC	Cell moving through Franklin County
SPSBOX	2231 UTC	Cells moving through ne Franklin and nrn Worcester
SPSBOX	2319 UTC	Cells moving through Hillsborough county, NH

Summary

WFO Taunton experienced its first severe convection episode during the afternoon 15 May 2004. This was an isolated case of pulse type convection, but was handled well by the warning team. The Albany study on severe pulse convection was the topic of focus for the 2003 Severe Weather Workshop at WFO Taunton. This included both group and team training on the technique. The WFO Albany technique was successfully incorporated into the radar operations and warning decision making throughout this event, and enabled the team to accurately determine which storm may produce severe weather.

Forecasters are encouraged to make use of the variety of severe weather cases resident on the Weather Event Simulator to practice radar techniques and to maintain their proficiency on radar and warning operations.

References

Cerniglia, C. S., and W. A. Snyder: Development of warning criteria for severe pulse thunderstorms in the northeastern United States using the WSR-88D. ERH-TA No. 2002-03.

Lemon, L. R., 1977: New severe thunderstorm radar identification techniques and Warning criteria. *NOAA Tech. Memo*. **NWS NSSFC-1**,. Kansas City MO, National Severe Storms Forecast Center, 60 pp.

Maxwell, C., 1996: Local research results on the likelihood of severe weather as a function of VIL Density. WFO Taunton Severe Weather Reference.